



Summer of Innovation



Mission to Planet Earth
4th – 9th grade

Introduction

The goal of the NASA Summer of Innovation Mission to Planet Earth camp is to excite young minds and inspire student trainees toward future science, technology, engineering, and mathematics (STEM) pursuits. Raising trainee achievement in STEM pursuits begins by leading trainees on a journey of understanding through these highly engaging activities. The activities and experiences in this guide come from across NASA's vast collection of educational materials.

This themed camp outline provides examples of one-day, two-day, and weeklong science and engineering programs. Each day contains 6-8 hours of activities totaling more than 35 hours of instructional time. The camp template will assist you in developing an appropriate learning progression focusing on the concepts necessary to engage in learning about the Earth. The Mission to Planet Earth camp provides an interactive set of learning experiences that center on the atmosphere, hydrosphere, cryosphere, biosphere, and geosphere of Earth. The activities scaffold to include cooperative learning, problem solving, critical thinking, and hands-on experiences. As each activity progresses, the conceptual challenges increase, offering trainees full immersion in the topics.

Intended Learning Experiences

Through the participation in these camps future scientists and engineers will have the opportunity to explore Earth science. Student trainees gain learning experiences that help make scientific careers something they can envision in their lives. Trainees realize that they have the potential to make a contribution to this field and ignite their curiosity to see what they might create during the program. The learning experiences also anticipate that trainees will have the opportunity to:

- Discover Earth's atmosphere, hydrosphere, cryosphere, biosphere, and geosphere
- Explore essential environmental resources available on Earth
- Review current and past data trends in climate change
- Collect and analyze data on the energy budget and water cycle of Earth
- Analyze the physical processes on Earth and elsewhere in the solar system
- Compare the atmospheric conditions of Earth by developing models of hot and cold planets
- Learn the essential role of NASA in understanding Earth

Professional Development

Educator Professional Development (PD) experiences are available. Webinars, NASA Digital Learning Network (DLN) programs, training videos, and online meeting spaces will help you implement the program. We hope that you and your trainees have a memorable and successful experience implementing these activities.

Professional Development Resources

- The [NASA Educator Online Network](#) is a great resource for STEM educators to share and learn about STEM topics. The Mission to Planet Earth camp hosts a group that will provide a place for sharing about the activities, additional resources, extension ideas, and support.
- Visit the [Summer of Innovation homepage](#) for an extensive catalog of news, media resources, and educational materials.

Format of the Guide

The Six E's

Each day or section of activities utilizes the 5-E Instructional Model. Included in this program guide is a sixth 'E' for Excite. This additional 'E' shows you how to incorporate NASA's unique information and resources to excite trainees with career connections, real world examples, spinoffs from NASA research, and more. Learn more about the [5-E Instructional Model](#).

\$ Requires simple materials common in the classroom or relatively inexpensive to obtain.

\$\$ Requires purchasing unique materials such as poster board, duct tape, or hot glue guns.

\$\$\$ Requires purchasing or building higher-cost items, though many are one-time purchases that may be used for many trainees over several years.

Title	Overview	Time	Cost	Additional Resources
The title hyperlinks to the activity.	An overview describes the main concepts and strategies used in the lesson, activity, or demonstration.	The time listed includes time for an introduction, activity time, and conclusion time.	Please find this camp or the activity you are using in the Resource Repository for more information on costs and tips.	Suggested resources may include additional lesson plans, posters, images, or other learning support materials.

Engage: Question?

Icons may appear throughout the program



A computer symbol means you may need one or more computers or other technology, though alternatives are available.



The pencil icon helps to identify the journal.

Journal

Journals are an optional element of your camp. Throughout the camp template, you will find reflective questions, ideas, and guidance in creating a journal. Journals also provide trainees with a unique souvenir of their experiences. Learn more about how scientists and engineers use journaling at NASA by watching this [eClip video: Journaling in Space](#).

One-Day Camp: Mission to Planet Earth


The one-day camp introduces the basic concepts of Earth's atmospheric, geologic, and hydrologic resources. Trainees will use knowledge gained to design and build a habitat to simulate the Earth environment.

Title	Overview	Time	Cost	Additional Resources
Engage: Where Do We Choose to Live and Why?				
Earth at Night: Part I	Trainees will construct puzzle pieces into a full image of the United States at night. Trainees analyze the patterns and spatial distribution of human settlements. This activity can be used to engage trainees as they arrive at camp at the beginning of the day. Ask them to work together and to discuss their ideas to be ready to share when the group convenes.	1.0 hr	\$	Where Do We Choose to Live and Why
Explore: What Makes a Planet a Good Home for Living Things?				
What Makes a Planet Habitable? Page 23	Trainees explore Earth's physical characteristics and the requirements for life. Includes a math extension for showing the "Goldilocks" zone for planetary habitability.	1.0 hrs	\$	Extreme Makeover: Planet Edition
Explain: What are Earth's Spheres?				
The Spheres of Earth	Trainees use astronaut photography to investigate atmospheric, geologic, and hydrologic resources on Earth. Complete Parts 1 and 2 only.	1.0 hrs	\$	Educator's Guide: The Spheres of Earth Air, Ice, Water, and Land Posters
Elaborate: Where Is Life on Earth?				
Earth at Night: Part II Identifying Unknown Regions of Earth	Review key concepts of the day while assessing trainee understanding of an unknown region of the world using another Earth at night image.	1.0 hrs	\$	Images from the NASA Earth Observatory
Where Does	Participants use cards and/or computer images to look at	45-60	\$	Print outs of image cards from the

Life Live? From the PP. 23-36 Astrobiology: Life Here and Out There	extreme environments and then match the environments with life forms they support. On large sheets of paper, participants summarize what they have learned about where life can exist. This activity expands participants' thinking about where on Earth life can exist by introducing several extreme environments and the microscopic life forms they support.	min.		Astrobiology Unit. One set of cards to be shared by 2-3 trainees. Large sheets of paper are to be shared by groups along with markers, crayons or pens.
Evaluate: Can You Design a Habitat?				
Living and Working in Space: The Sealed Room	Trainees will use critical thinking skills to design and construct a habitat for an unknown region of Earth to keep humans healthy for an extended period of time.	2 hrs	\$\$	Educator's Guide to the Sealed Room Assessment Rubric
Excite: NASA Connection				
Video	At any point during the day, trainees can watch a video on the extended exploration of space and the moon.	0.5 hrs	\$\$	Field Trip to the Moon: LRO/LCROSS Edition Informal Educator Guide LRO/LCROSS Edition <i>*Video must be ordered from CORE</i>
Total		7.5 hrs		

Two-Day Camp – Day One: Earth and Its Resources


The two-day camp introduces the basic concepts of Earth's atmospheric, geologic, and hydrologic resources. Trainees will use knowledge gained to design and build a habitat to simulate the Earth environment. The two-day camp explores Earth's resources with more depth and breadth than the one-day camp, though the outcomes are similar.

Title	Overview	Time	Cost	Additional Resources
Engage: Where Do We Choose to Live and Why?				
Earth at Night	Trainees will construct puzzle pieces into a full image of the United States at night. Educators will use engaging questions to probe trainees about where we choose to live and why. Trainees analyze the patterns and spatial distribution of human settlements.	1.0 hrs	\$	Where Do We Choose to Live and Why Air, Ice, Water, and Land Posters
Explore: What Are Earth's Spheres?				
The Spheres of Earth	Trainees use astronaut photography to investigate the Earth Spheres. Complete Parts 1 and 2 only.	1.0 hrs	\$ 	Using Scrapbooks in Science Educator's Guide: The Spheres of Earth
Explain: What Is the Distribution of Water Resources on Earth?				
Water, Water Everywhere Page 26	Trainees complete an activity showing the amount of water resources available on Earth. The trainees place water in labeled buckets and estimate how much water should be moved to other buckets to model the amount of water in oceans, lakes, and underground.	1.0 hrs	\$	National Atlas Maps Water Lessons, Games, Posters, and More
Explain: How Do Clouds Form?				
Cloud in a Bottle	Trainees make a cloud in a bottle or educators use a cloud in a bottle as a demonstration.	0.5 hrs	\$	Video: Clouds and How They Are Formed
Elaborate: What Is the Structure and Composition of the Atmosphere?				
How High Is It? Page 22	Trainees make a six-page-high chart showing five layers of Earth's atmosphere. They cut out pictures of NASA aircraft, satellites, and spacecraft and graph where these NASA vehicles fly or orbit.	1.5 hrs	\$	Earth's Atmosphere Video
Excite: How Does NASA Look at Clouds?				

Detecting Clouds Using Infrared Energy Page 23	Trainees use infrared images of Earth to make a map of cloud temperatures. This hands-on experiment shows how NASA imagery is produced and used to monitor climate.	1.5 hrs	\$\$	Studying Clouds from Space: How Satellites See Clouds
Total		6.5 hrs		



Two-Day Camp – Day Two: Planetary Habitats

On day two of the program, trainees work in teams to better understand the moon. By understanding the moon, they can recognize the similarities and differences between Earth's resources and those on the moon.

Title	Overview	Time	Cost	Resources
Explore: What Makes a Planet a Good Home for Living Things?				
What Makes a Planet Habitable? Page 23	Trainees explore Earth's physical characteristics and the requirements for life.	0.5 hrs	\$ 	Astroventure Extreme Makeover: Planet Edition
Explain: What Can the Moon Teach Us About Habitability?				
Field Trip to the Moon – Lunar Base Activities Page 37	Trainees are divided into teams with the task of exploring the moon, its resources, and habitability. Trainees will compare what they know about Earth with this information about the moon.	3.5 hrs	\$\$	Video: Why Return to the Moon? Moon and Earth Comparison Chart
Evaluate: Can You Design a Habitat?				
Living and Working in Space: The Sealed Room	Trainees will use critical thinking skills to design and construct a habitat to keep humans healthy for an extended period of time.	2.0 hrs	\$\$	Educator's Guide to the Sealed Room Assessment Rubric
Excite: NASA Connection				
Video	At any point during the day, trainees can watch a video on the extended exploration of space and the moon.	0.5 hrs	\$\$	Field Trip to the Moon: LRO/LCROSS Edition Informal Educator Guide LRO/LCROSS Edition <i>*Video must be ordered from CORE</i>
Total		6.5 hrs		

Weeklong - Day One: Earth's Natural Resources and Habitability


The focus of the weeklong camp is to introduce trainees to the basic characteristics of Earth and its resources. The activities give trainees a chance to explore the Earth as a whole by looking at Earth and its place in the solar system. Day one will also introduce the Mission to Planet Earth Journal that trainees will keep all week to document learning. In addition to serving as a scientific recording tool, the journal can be used as an assessment tool and souvenir of the week. The goal of the program is for each trainee to be a part of a team that works to learn more about Earth's habitability and the preservation of the resources that make habitation possible.


Title	Overview	Time	Cost	Resources
Engage: Where Do People Choose to Live on Earth and Why?				
Where Do We Choose to Live and Why? Page 3, Parts 1 and 2 only	Trainees construct puzzle pieces into a full image of the United States at night. Educators use engaging questions to probe trainees about Earth's habitable zones. Trainees analyze the patterns and spatial distribution of human settlements.	1.0 hrs	\$	NOAA Posters on Earth Lights Interactive: Eyes On the Earth Interactive: 10 Things You Never Knew About Earth
Explore: What Are Earth's Spheres?				
The Spheres of Earth	Trainees use astronaut photography to investigate the Earth Spheres. The remaining days in the camp support each of the Earth spheres making this activity act as a running theme throughout the week. Complete Parts 1 and 2 only.	1.5 hrs	\$ 	Using Scrapbooks in Science Educator's Guide: The Spheres of Earth Air, Ice, Water, and Land Posters
Explore: Where Is Earth in the Solar System?				
 Journal: Draw a model of the solar system in your journal, with an explanation that helps you to think about the distances between planets.				
Solar System Bead Distance Activity	The trainees calculate distances between the sun, planets, and small objects in the solar system by converting astronomical units to centimeters. The trainees create a model demonstrating the scale distances of the solar system using strings and beads.	1.5 hrs	\$	Make a Human Solar System Explorer's Guide to the Solar System presentation Your Weight on Other Worlds
Explain: What Makes Earth So Special?				

Is It Living? Page 10	Trainees collect and observe objects from their nearby environments for discussion on the requirements for life.	1.0 hrs	\$	The NASA Habitat Demonstration Unit (HDU) NASA Desert RATS
Elaborate: Can You Identify Living Things?				
Do the Mystery Samples Contain Life? Page 13	Trainees explore the properties of three mystery samples containing yeast and antacid tablets to determine which contain life.	1.5 hrs	\$\$	NASA Astrobiology Graphic Novel Space School Musical
Total		6.5 hrs		



Weeklong - Day Two: Life and the Air We Breathe

Day Two introduces trainees to Earth's biosphere and atmosphere. Trainees perform a series of experiments and conduct activities meant to broaden their knowledge of these earth systems.

Title	Overview	Time	Cost	Resources
Elaborate: What Can Extreme Environments on Earth Teach Us About the Solar System?				
What Can Life Tolerate? Page 37	Trainees read about organisms living in extreme environments on Earth. Trainees then play a card game reinforcing the concepts presented. (<i>Note:</i> The guide still discusses the solar system as having nine planets.)	1.0 hrs	\$\$	Astrobiology In Your Classroom Educator Guide Alien Safari Online Interactive
Evaluate: What Factors Make a Location Habitable?				
Welcome to My Habitat Page 18	Trainees design an Earth habitat in a shoebox. Trainees will continue to modify and adjust the characteristics of their habitat over the course of the remaining 4 days.	1.0 hrs	\$\$	The New Worlds Atlas Solar System Missions
Explore: What Is the Structure and Composition of the Atmosphere?				
How High Is It? Page 22	Trainees make a six-page-high chart showing five layers of Earth's atmosphere. They cut out pictures of NASA aircraft, satellites, and spacecraft and graph where these NASA vehicles fly or orbit.	1.0 hrs	\$	Earth's Atmosphere Video
 Journal: What do you know about the habitability of each of these layers for people? What kinds of limitations could keep people from spending time in them if they could manage to stay there without an aircraft?				
Explain: What Is in the Air and Why Should I Care?				
Aerosol Activity: Salty Water	Trainees perform a simple experiment that demonstrates a method of atmospheric aerosol formation using salt. The activity simulates aerosols from ocean water. Educators are prepping trainees for a basic understanding of cloud formation and climate.	0.5 hrs	\$	Atmospheric Aerosols Fact Sheet Changing Global Cloudiness
Aerosol Lab Activity	Trainees collect and examine air particles, then describe the way gas volumes (the amount of gases) and	1.0 hrs		Atmospheric Science Trading Cards





	pressure change in each layer of the atmosphere.			Atmospheric Aerosols Interactive Book
 Journal: What impact do you think each different level of air pressure would affect humans?				
Explain: How Do Clouds Form?				
Cloud in a Bottle	Trainees make a cloud in a bottle or educators use a cloud in a bottle as a demonstration.	0.5 hrs	\$	Video: Clouds and How They Are Formed
How Clouds Form: Understanding the Basic Principles of Precipitation Page 51	Trainees use inquiry skills to determine the conditions necessary for cloud formation. This activity enhances the understanding of the change of state concept, which is important in the study of meteorology and the atmosphere.	1.5 hrs	\$\$	NASA Cloud Resources: Posters, Games, and Interactives NASA SciJinks Weather Games
Total		6.5 hrs		

Weeklong - Day Three: Energy and Climate

Title	Overview	Time	Cost	Resources
Engage: How Do Clouds Affect Climate?				
Exploring Albedo	Trainees use various colored papers to determine albedo and effects on temperatures.	1.0 hrs	\$	Science Brief: Clouds and Climate Change Clouds and Radiation Fact Sheet
 Journal: How do you think these changes in temperature will affect the water on Earth?				
Explore: How Do Air and Water Absorb Heat?				
Oceans of Climate Change Video	Educators perform a demonstration for trainees showing the difference between heat capacity in the atmosphere and the oceans.	0.5 hrs	\$	Eyes On the Earth: 3-D Interactive SciJinks: Clouds, Water, and Ice Activities
Explain: How Does NASA Look at Clouds?				
Detecting Clouds Using Infrared Energy Page 23	Trainees use infrared images of Earth to make a map of cloud temperatures. This hands-on experiment shows how NASA imagery is produced and used to monitor climate.	2 hrs	\$	Studying Clouds from Space: How Satellites See Clouds
Elaborate: How Does the Climate System Work?				
How Do Atmospheres Interact with Solar Energy? Activity A	The trainees perform a series of simulations to review how greenhouse gases produce this warming effect. Emphasis is placed upon the relatively low concentrations of these gases in the Earth's atmosphere and the magnitude of their effect upon the surface temperature. Trainees review how Greenhouse gases emit infrared radiation back to a planet's surface, thus increasing its temperature.	2 hrs	\$\$	Energy Budget Diagram
 Journal: What have you heard about the effects of Greenhouse gases? Did you learn anything new today about Greenhouse gases?				
Extend: How Much Carbon Does the United States Produce?				
Earth Math:	The activity uses math integration to show how much carbon	1.0 hrs	None	Global Climate Change Professional





Carbon Production in the United States Problem #39	dioxide the United States produces based on location. Trainees examine a United States Map, calculate, and draw conclusions in their journals. The activity should be directly connected with the previous Earth at Night exercise.		Development Opportunities Take Aim at Climate Change Music Video
Total		6.5 hrs	

Weeklong - Day Four: Water, Water, Everywhere

Title	Overview	Time	Cost	Resources
Engage: What Is the Distribution of Water Resources on Earth?				
Water, Water Everywhere Page 26	Complete a educator demonstration showing the amount of water resources available on Earth. Educators place water in buckets and ask trainees to estimate how much water should be moved to each labeled bucket to model the amount of water in oceans, lakes, and underground.	45 min	\$	Interactive: Ocean Surface Topography Interactive: The Sea Level Viewer
 Journal: Were you surprised by the amounts of water in the kinds of places you learned about today? Does it change your thinking about any places that you go to?				
Excite: What is Earth's Cryosphere?				
The Global Ice Viewer	Earth and its water resource are presented in an interactive format. Trainees can explore the site individually, or educators can show the site to a whole group. Web exploration may occur at any point in the day.	45 min	None 	NASA Cryospheric Science Division Introduction to Ice Trainee Reading
Explore: How Does Water Move Through the Water Cycle?				
Droplet and the Water Cycle	Trainees explore the water cycle using an online game activity. Trainees must answer questions about the water cycle to advance to the next level in the game.	1.0 hrs	None 	Background Reading on Water Cycle
 Journal: How well did you do in the game? Did you know many of the answers? What do you still want or need to learn about?				
Explain: How Does Water Play a Role in Shaping Earth's Surface?				
Model a Catchment Basin	This activity introduces what a catchment basin is and how it works. The trainees construct a 3-D model of a catchment basin and use the model to investigate basins and water pathways. Use NASA satellite images to further explore the basins and water pathways.	2.5 hrs	\$	NASA Earth Observatory Images
Elaborate: What Surface Features Are Present on Earth?				
What	In this activity, trainees work in pairs to compare and	1.0 hrs	\$	Mars Lakes

Physical Processes Occur on Both Earth and Mars?	contrast the physical processes that may be inferred through the observation of images of both Mars and Earth.			Mars Geology
Total		6 hrs		

Weeklong - Day Five: Earth's Climate and Habitability

Title	Overview	Time	Cost	Resources
Engage: How Does Climate Affect the Earth System?				
The Influence of Global Warming on Earth Systems	Trainees watch a video on how climate affects the Earth system. Educators should have trainees review and discuss knowledge and concepts from the previous days.	0.5 hrs	None 	The NASA Climate Time Machine
Excite: How Do Earth’s Spheres Make Our Planet Habitable?				
Extreme Makeover: Planet Edition	Trainees use an interactive website to model the conditions necessary for life by creating their own planet. Trainees adjust characteristics about each of Earth’s spheres to make a habitable planet elsewhere in the universe.	1.0 hrs	None 	NASA Astrobiology Roadmap Astrobiology Classroom Poster
	Journal: You learned about lots of different topics this week. Which one or ones would you like to spend more time learning about? What do you think about a future job working in that area? Draw a picture of yourself working in that area, or write about what you would like to do and what you would hope to learn. Try the NASA Careers Survey .			
Project: Modeling Planetary Habitability				
Modeling Hot and Cold Planets	Trainees conduct and design model planetary conditions to determine the variables that make planets, such as Earth, habitable. Trainees use knowledge from the previous days experiments to complete this culminating activity.	3 hrs	\$\$	Trainee Pages for Modeling Hot and Cold Planets Blue Marble Matches: Using Photos for Planetary Comparisons
	Journal: What have you learned this week? What new questions do you have? How will your new understanding change your behavior			
Community Showcase				
Trainees showcase their journals, hot and cold planet models, and habitats to each other, parents, educators, and community members.		1.5 hrs	None	
Total		6 hrs		